Naval School of Health Sciences

Self-Study Course 3030-G

Special Publication

Principles of Epidemiology

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MANUAL 1

SELF-STUDY COURSE 3030-G
Principles of Epidemiology

SELF-STUDY

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PRINCIPLES OF EPIDEMIOLOGY

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INTRODUCTION

Epidemiology is the study of the occurrence of disease in a human population. The term is derived from the Greek words, epi meaning on or upon, demos meaning people, and logos meaning the study of. Epidemiology had its beginning with the studies of the great epidemic diseases such as bubonic plague, cholera, and smallpox which occurred in waves and which were characterized by high mortality rates. As the science advanced, it was applied to the study of "disease" in the broadest sense of the word. Consequently, we speak of the epidemiology of heart disease, measles, or accidents, because each disease has the same elements: the disease determinants, the human population in which the disease occurs, the the distribution of the disease in a population. Various investigators have developed their own definitions of epidemiology, but all basically address these elements.

The following terms are used to describe the extent of the occurrence of disease:

Endemic: The usual presence of a disease within a geographic area defines "endemic"; it may also refer to the usual prevalence (number of cases) of a disease within a geographic area.

Epidemic: An occurrence of disease within a geographic area clearly in excess of the normal expectancy (the endemic level), and transmitted either from a common (single) source or from sources propagated from a single source.

Pandemic: An epidemic that affects several countries or continents or much of the world.

EVOLUTION OF EPIDEMIOLOGY

Epidemiology has evolved to its present status as knowledge of the physical world has increased over the centuries. Significant contributions to the study of disease and causation were made by:

Hippocrates (circa 400 B.C.) who was the first to attempt to explain disease occurrence from a rational instead of a supernatural standpoint, and to associate diseases with environmental factors.

Fracastoro, a 16th century Italian who suspected that minute infective agents caused disease. He also recognized three modes of transmission: person-to-person; at a distance, as by air; and by intermediate objects such as personal articles.

Jenner, who experimented with inoculating individuals with material containing cowpox viruses. His detailed description of the results, published in 1798, led to the general acceptance of cowpox vaccine as a reliable method of immunizing populations against smallpox.

Panum (1846), who recognized differences in the frequency and distribution of measles in island populations--one semi-immune and one non-immune. Panum's work contributed added emphasis to the importance of epidemiologic field studies.

These men worked without knowledge of the existence of microorganisms. Using common sense and logic, they recognized the importance of the interrelationships between the host and the environment that bear on the occurrence of disease.

John Snow's classic epidemiologic studies in the mid-1800's are the prime example of early attempts to not only discover the cause of disease but to prevent its recurrence. Snow's first study was conducted in 1848 when an epidemic of cholera developed in the Golden Square of London. His first step was to acquire information concerning the residence or the place of work of cases which developed within this area. With this information, he developed a spot map (figure 1) which illustrated the distribution of cases. Since water was suspected to be a source of infection, he also showed the locations of pumps within the area.

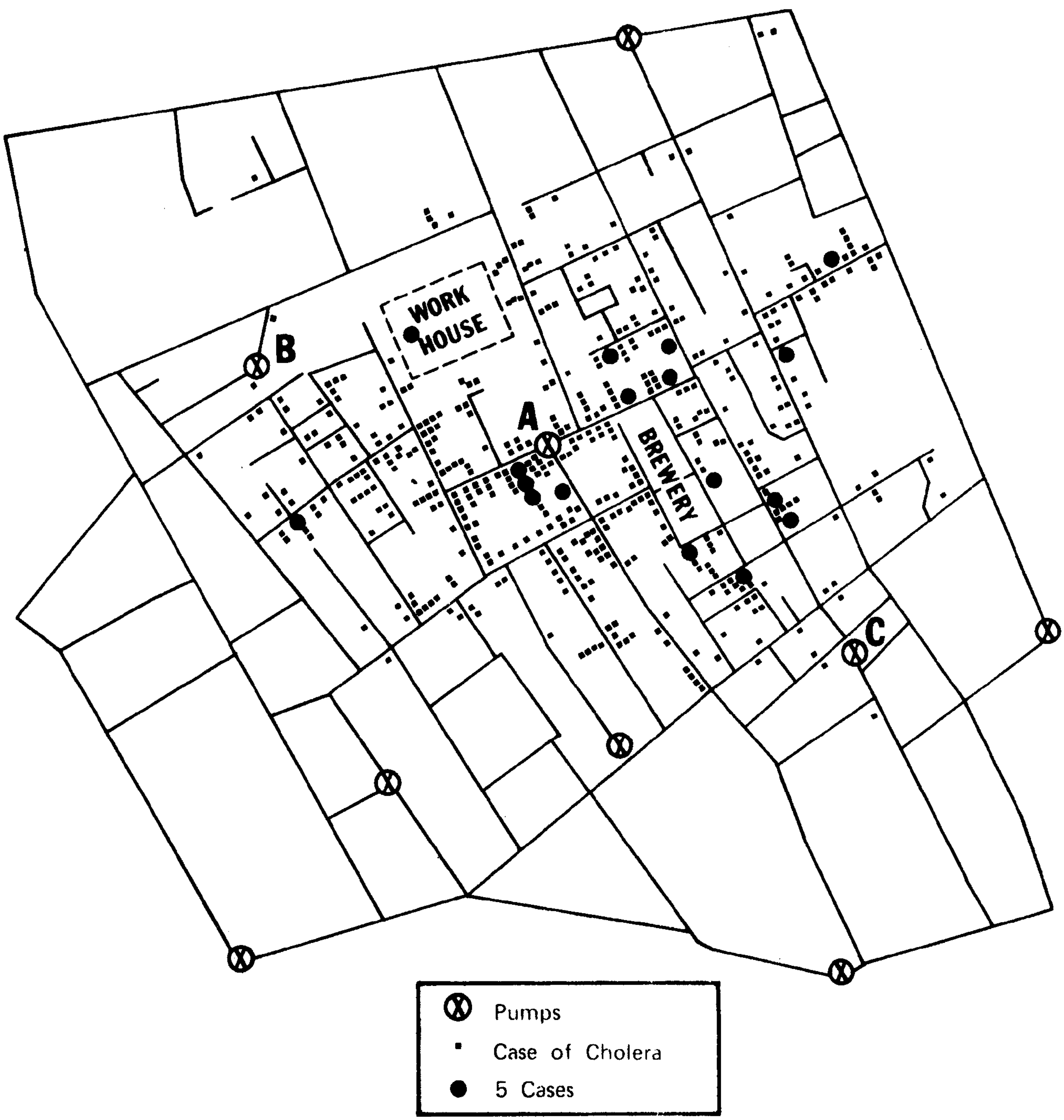
Because of the clustering of cases around Pump A (Broad Street pump), Snow concentrated his attention on this water source as the most likely to account for this observed distribution. The absence of clusters of cases around Pumps B and C suggested they were less likely to be sources. Investigation of the water from Pump B disclosed that it was grossly contaminated and was avoided by residents of this area, who obtained their water from the Broad Street pump. Pump C was located so that it was difficult for the majority of cases to have used it. To confirm his suspicions that Pump A was the source of the epidemic, he gathered information from the cases about their source of water. The consumption of water obtained from the Broad Street pump (Pump A) proved to be the one factor common among these cases.

The absence of cases in the two-block area a block to the east of the Broad Street pump could have indicated that this area had no residents. Snow found, however, that a brewery was located here. The brewery workers got their water from a deep well on the premises and were alloted a daily quota of malt liquor as well. Their consumption of these uncontaminated rations could explain why none of them contracted cholera. This study enabled Snow to demonstrate that patterns of the incidence and distribution of cases could be used to identify a source of an epidemic.

Snow also studied an epidemic of cholera which occurred in London in 1854. In studying the distribution of cholera deaths, he noted a definite pattern which appeared to be associated with the water supply districts. The distribution of cases suggested that populations living within the districts supplied exclusively by the Southwark and Vauxhall Company had significantly more deaths than populations residing in the districts supplied exclusively by

Figure 1

Distribution of Cholera Cases in the Golden Square Area of London, August--September, 1848



Source: Adapted from Snow, J., On The Mode of Communication of Cholera (Second edition). 1855. Churchill, London.

the Lambeth Company. To confirm his suspicions, he established mortality rates for the three water supply districts shown in table 1.

Table 1

Mortality from Cholera in the Districts of London Supplied by the Southwark and Vauxhall, and the Lambeth Companies, July 9—August 26, 1854

Districts with Water Supplied by	Population 1851	Deaths from Cholera	Death Rate Per 1,000 Population
Southwark and Vauxhall Co.	167,654	844	5.0
Lambeth Co.	19,133	18	0.9
Both Companies	300,149	652	2.2

Source: Same as Figure 1

It is evident that the risk of death from cholera is over five times higher in districts served by the Southwark and Vauxhall Company than in districts served by the Lambeth Company. Also of interest to Snow was the mortality rate in districts supplied by both companies, which fell between the rates of the other two groupings. Further investigations confirmed his hypothesis that cholera was being spread in water supplied by the Southwark and Vauxhall Company. This company's water intake was found to be near a major source of contamination. The Lambeth Company's was not. Efforts to control the epidemic were directed at changing the location of the water intake to avoid sources of contamination.

As a result of these two epidemiologic studies, Snow, working without knowledge of the existence of microorganisms, conclusively demonstrated that water could serve as a vehicle for transmitting cholera.

Although Snow had forcefully postulated the existence of a microorganism as the cause of cholera, his concept was not accepted until the germ theory was confirmed by the work of Pasteur and Koch, during the period 1860-1890.

The stimulus supplied by the work of these two men caused a sudden shift of emphasis to bacteria, rather than environmental factors, as the direct cause of many diseases. Since techniques for assessing the role of the environment and host resistance in disease causation were practically nonexistent, this emphasis placed upon biological agents was to be expected.

THE PRESENT APPROACH: AGENT, HOST, AND ENVIRONMENT:

The present epidemiologic approach is based upon the interaction of the host, the causative agent, and the environment. Among these factors there exists a dynamic situation in which efforts to prevent and/or control disease are constantly challenged: populations are highly mobile and tend to live longer, thereby creating circumstances of increased risk of exposure and infection; urbanization and suburbanization have exerted greater and greater pressures on the environment; biological agents of disease have shown remarkable adaptability to modern control measures; nonbiological agents are often introduced into the milieu despite precautions of interested groups.

The science of epidemiology emerged and evolved from the study of infectious diseases. However, its application has extended to the study of noninfectious diseases and to the study of health conditions in general. We may, therefore, speak of the epidemiology of heart disease, accidents, cancer, and hypertension. The same principles of interaction among the agent(s), host, and environment apply.

AGENT FACTORS

The current scope of epidemiology requires an expansion in perception of the causative agents of disease. Causative (etiologic) agents are not limited to biological agents; they may also be chemical or physical:

Biological Agents	Chemical Agents	Physical Agents
Protozoa	Pesticides	Heat
Metazoa	Food-additives	Light
Bacteria	Pharmacologics	Ionizing-radiation
Viruses	Industrial chemicals	Noise
Rickettsia		Vibration
Fungi		Speeding objects

HOST FACTORS

Host factors include a wide variety of characteristics.

Examples of Host Factors

Age	Socioeconomic Status	Lifestyle
Sex	Marital Status	Heredity
Ethnic Group	Previous Disease	Nutrition

All of the preceding host factors, and some others, are important to the extent that they affect, first, the risk of exposure to a source of infection, and second, the host's resistance or susceptibility to infection and disease.

Age usually is the single most important host factor related to disease occurrence. The influence of malnutrition--both under and over nutrition--is gaining more importance even in the relatively affluent and apparently well-fed populations of the United States. The connection between malnutrition and decreased general and specific host-resistance is slowly being disclosed.

ENVIRONMENTAL FACTORS

Some of the numerous environmental factors are:

Water	Housing conditions
Milk	Noise
Food	Meteorological conditions and effects
Plants	Environmental pollutants
Animals	

The agent-host-environment factors interrelate in extremely varied combinations to produce disease in humans. Investigators should be aware of this fact to assist them in analyzing disease problems and to reach proper conclusions regarding prevention and control measures.

While the scope of epidemiology encompasses the occurrence of all types of disease and health conditions, the principles of epidemiology will be applied to infectious diseases in this course.

THE INFECTIOUS DISEASE PROCESS

Infectious disease results from the interaction of the agent, host, and environment in a process which involves six components. These six components comprise the infectious disease process, or as it is sometimes called, the "chain of infection:"

1. Causative agent
2. Reservoir of the agent
3. Portal of exit of the agent from the host
4. Mode of transmission of the agent to a new host
5. Portal of entry into the new host
6. Host susceptibility

Knowledge of the chain of infection for specific diseases is important to identify the most appropriate control measures.

Causative (Etiologic) Agents

There are six basic categories of biological etiologic agents. The species capable of causing human disease are termed pathogens.

Protozoa: Unicellular animals that cause malaria, trypanosomiasis, leishmaniasis, amoebic dysentery, and other diseases. Many of these, excluding amoebic dysentery, also have an extra-human developmental stage and are usually vectorborne.

Metazoa: Multicellular animal parasites that cause such diseases as trichinosis, hookworm, and schistosomiasis. These commonly have an extra-human developmental stage and, therefore, are not directly transmissible from man to man.

Bacteria: Unicellular plant-like organisms that cause a wide variety of diseases including tuberculosis, meningitis, salmonellosis, and staphylococcal intoxication. Many bacteria that cause disease can multiply in man and in the environment. The agents of some bacterial diseases are transmissible directly from man to man; others are acquired from environmental sources.

Viruses: The smallest of the pathogens. Some diseases caused by viruses are smallpox, measles, rubella, influenza, rabies, encephalitis and trachoma. These diseases are usually directly transmissible from man to man.

Fungi (yeasts and molds): Unicellular and multicellular plants responsible for such diseases as ringworm, histoplasmosis, coccidioidomycosis, and blastomycosis. The usual reservoir for fungi is soil. Commonly, fungal diseases are not transmissible directly from man to man.

Rickettsia: Intracellular parasites that are intermediate in size between bacteria and viruses and share characteristics of both categories. They are similar to the viruses in requiring living cells for growth and multiplication. Some diseases caused by rickettsia are louse- and tick-borne typhus and Q-fever.

These foregoing agents are the direct cause of infectious disease. Factors that enhance their capabilities to cause disease vary among the categories of biological agents as well as between members of any single category. Such factors include host specificity, ability to survive or multiply outside the host, and virulence.

The capacity of these agents to infect and to produce subsequent disease (pathogenicity) in humans and animals is variable and usually manifested in a spectrum of signs and symptoms. Not all persons equally exposed to an infectious agent become infected. Of those who do, some may remain asymptomatic throughout the course of the infection (inapparent infection) while others develop signs and symptoms of illness (apparent infection) which may be quite variable in duration and degree (table 2). The severity of apparent infections is measured in terms of associated morbidity and mortality. Infectious diseases such as rabies and tetanus have high case-fatality rates reflecting the severe threats to life associated with these infections.

Table 2

Classification of Hepatitis A (Based on the Severity of Symptoms) Among Members of the Football Team of the College of the Holy Cross, Worcester, Massachusetts, September and October, 1969

Classification	Cases	
	Number	Percent
1. Symptomatic	54	60
a. With jaundice	32	36
b. Without jaundice	22	24
2. Asymptomatic	36	40
TOTAL	90	100

Source: JAMA, February 7, 1972. Vol. 29 No. 6

Ratios: (1) Cases with jaundice : Cases without jaundice = 32:(36 + 22) = 32:58 = 0.6:1

(2) Symptomatic cases : Asymptomatic cases = 54 : 36 = 1.5:1

In addition to the spectrum of signs and symptoms (i.e., the disease syndrome) caused by any particular agent, additional problems are associated with the fact that a variety of biological agents may produce essentially similar clinical syndromes. Signs and symptoms of histoplasmosis, tuberculosis, and infections due to other mycobacteria may be essentially the same.

Historically, the recognition of histoplasmosis was delayed because in its mildest form it resembles influenza and in its cavitary form, tuberculosis. Until 1938 physicians and radiologists erroneously assumed that practically all pulmonary lesions seen in chest X-rays were caused by tubercle bacilli. Many people thought to have tuberculosis on the basis of chest X-rays were skin-tested and found to be negative. Identification of the agent involved often proved that the disease was in fact histoplasmosis and not tuberculosis. This situation led to a renewed interest in the value and use of the tuberculin skin test.

Another problem developed due to the similarity of diseases caused by infections with M. tuberculosis and other mycobacteria. Many persons in the past were diagnosed as having and were treated for tuberculosis when in fact their disease was actually due to other mycobacteria.

These misconceptions arose because many assumed that a sputum smear containing acid-fast bacilli indicated the presence of M. tuberculosis. Later, it was found that cultures were required to identify the various acid-fast bacilli.

RESERVOIRS OF THE AGENT

The reservoir is defined as the normal habitat in which an infectious agent lives, multiples, and/or grows. These habitats include man, animals, and the environment.

The two major categories of human sources of infection are acute clinical cases and carriers. Acute clinical cases are usually less likely to cause transmission since the associated disability results in fewer contacts and is more likely to result in early diagnosis and specific treatment.

Carriers are persons who harbor infectious agents and who have no overt signs and symptoms. Carriers may be characterized as inapparent infections, incubatory, convalescent, or chronic. All such individuals may transmit their infection to others and are particularly dangerous from the standpoint of disease transmission for they, as well as their contacts, are completely unaware of the presence of infection and consequently take no special precautions to prevent transmission of their infection to other people.

Inapparent infections (subclinical cases): Those individuals who have an infection but show no signs or symptoms. Such cases occur with considerable frequency in many diseases. Epidemiologic studies of poliomyelitis indicate that of 100 individuals infected, one infected person will develop paralytic disease, four infected persons will develop nonparalytic disease, and 95 infections will remain inapparent. In the case of hepatitis A, the ratio of cases with jaundice to those not experiencing jaundice increases with age. As with poliomyelitis, the majority of cases of hepatitis A in young children result in inapparent infections since jaundice is not a common manifestation in children. In children there may be 10 or more inapparent infections for each case of jaundice which develops. In adults, this ratio may be 2 to 1 or 1 to 1. In the case of meningococcal meningitis, the carrier rate may be as high as 5 to 10 percent among community populations and considerably higher on military bases.

Incubatory carriers: Those persons who are capable of transmitting infection prior to the onset of signs and symptoms of the disease. For some diseases, incubatory carriers do not exist, while for others such carriers may exist for months prior to the onset of illness. In hepatitis B, the blood of infected persons may be infectious as long as 3 months prior to the onset of jaundice. In dog rabies, the virus may be present in the saliva within 5 days prior to the onset of symptoms. The incubatory carrier state in rabies has been employed to determine a satisfactory holding time, of 7 to 10 days, for dogs that have bitten humans. If a dog does not develop signs and symptoms of rabies within this time, there is little likelihood that infection was transmitted as a result of the bite.

Convalescent carriers: Those individuals who, after experiencing acute illness, continue to be infectious during and after their return to health. In many diseases, a small percentage of individuals will be found to be infectious during and after the convalescent period. The improper use of drugs in treating salmonellosis patients has been found to increase the liklihood of a patient becoming a convalescent carrier.

Chronic carriers: Those individuals who continue to harbor infectious agents for a year or more. This situation is encountered in typhoid fever, viral hepatitis, shigellosis, and other diseases. The percentage of infected individuals who become chronic carriers is quite small.

The animal reservoirs of infection can be characterized as were human reservoirs (i.e., in terms of acute clinical cases and carriers). In some rickettsial diseases ticks and other animals serve as a reservoir of infection. With respect to ticks, infection may be transmitted transovarially from parent to offspring and transstadially from one developmental stage (stadium) of the tick to the subsequent stage. Some other diseases having an animal reservoir are:

Brucellosis	Q-fever
Leptospirosis	Rabies
Plague	Tetanus
Psittacosis	Tularemia

Plants, soil, and water in the environment can be reservoirs of infection for a variety of diseases. Many of the agents that cause mycotic (fungal) infections, such as histoplasmosis and coccidioidomycosis, live and multiply in the soil.

PORTALS OF EXIT OF THE AGENT FROM THE HOST

The path by which an infectious agent leaves its host is commonly referred to as the portal of exit. The portals discussed here are those associated with human and animal reservoirs.

Respiratory tract: The respiratory portal is common to many diseases, such as the common cold, influenza, and tuberculosis. Diseases caused by agents using this portal are among the most difficult to control.

Genitourinary tract: The genitourinary portal of exit is associated with such diseases as syphilis, gonorrhea, schistosomiasis, and leptospirosis.

Alimentary tract: In terms of the alimentary portal, the mouth may be involved as in rabies and other diseases transmitted by bites. There are also the various enteric diseases such as hepatitis A, typhoid, cholera, and dysentery which escape by means of the intestinal tract. In general, diseases caused by agents that use this portal are easier to control.

Skin: The skin can be a portal of exit through superficial lesions and percutaneous means. Smallpox, and syphilis in the primary and secondary stages, are representative of diseases with superficial lesions serving as portals of escape. The percutaneous mechanism involves escape or entry through the skin as a result of bites by arthropods or of penetrating objects such as needles.

Transplacental mode (mother to fetus): Generally, the placenta serves as an effective barrier for the fetus against maternal infections. However, this barrier is not completely effective against the agents of some diseases, such as rubella, syphilis, hepatitis B, and toxoplasmosis.

MODES OF TRANSMISSION OF THE AGENT TO A NEW HOST

A mode of transmission is essential for the infectious agent to bridge the gap between the portal of exit from the reservoir and the portal of entry of the host. Modes of transmission can be classified as direct or indirect.

Direct: The direct mode implies immediate transmission as in the case of contact or droplet spread. The role of contact in the direct transmission of disease is well illustrated by the spread of venereal and enteric diseases from person-to-person. Contact with soil may lead to a variety of mycotic diseases. In the case of droplet spread, infectious aerosols are produced by talking, sneezing, and coughing, which may transmit infection to susceptible individuals within a distance of approximately 3 feet. Many respiratory diseases are spread in this fashion.

Indirect: The indirect mode of transmission may be accomplished through animate or inanimate mechanisms. Animate mechanisms involve such vectors as mosquitoes, fleas, and ticks. Infectious agents may be transmitted through purely mechanical means or subsequent to growth and multiplication of the infectious agents in the vector. Inanimate mechanisms of indirect transmission involve spread by means of air or vehicles. Vehicles consist of any substances, including objects, food, water, milk, or biological products, by means of which an infectious agent is transported and introduced into a suitable host portal of entry. The airborne mechanisms resulting in indirect transmission involve respiratory droplet nuclei (dried residue of a droplet) and dust. As in the case of tuberculosis and other respiratory diseases, aerosols which are produced may result in the formation of particles in the 1 to 5 micron range containing one or several infectious organisms. Such particles may remain suspended in the air and remain infectious for varying lengths of time. Such particles are particularly dangerous since they are of such size that they are quite easily drawn into the lungs and retained. Air may also serve to spread particles of varying size arising from contaminated items, such as floors and clothing, as well as to distribute etiological agents present in the soil, as in the case of coccidioidomycosis and histoplasmosis.

PORTALS OF ENTRY INTO THE NEW HOST

The portals of entry of an organism into the host are essentially the same as those employed for purposes of escape. In the case of respiratory diseases, the respiratory tract is both the portal of escape and the portal of entry. In other diseases the portals vary as in staphylococcal infections in which the agent exits through open skin lesions and enters the new host through the ingestion of contaminated foods.

HOST SUSCEPTIBILITY

Susceptibility of the host is dependent upon genetic factors, general factors of resistance and specific acquired immunity. Among the general factors conferring some degree of resistance to infection are the skin and mucous membranes, gastric acidity, cilia in the respiratory tract, and cough reflex. Factors which increase susceptibility include malnutrition, pre-existing ill health, and artificially depressed immunologic response mechanisms which result from various methods of treating other diseases. Host resistance to disease is increased to the greatest extent by specific acquired immunity, which may be obtained naturally or artificially. Natural mechanisms involve the acquisition of protective antibodies by experiencing an infection (active) or by means of transplacental transfer from mother to newborn (passive). Artificial mechanisms of acquiring such antibodies involve the administration either of vaccines or toxoids (active), or of antitoxins or immune serum globulin (passive).

EPIDEMIOLOGIC VARIABLES

The methods and techniques of epidemiology are designed to detect a causal association between a disease and a characteristic of the person who has it or a factor in his environment. Since neither populations nor environments of different times or places are identical, these characteristics and factors are called epidemiologic variables. These variables are studied since they determine the individuals and populations at greatest risk of acquiring a particular disease, they give clues as to the etiology of the disease, and knowledge of these associations may have predictive value.

For the purpose of analyzing epidemiologic data, it has been found helpful to organize that data according to the variables of time, place, and person. Time refers both to the period during which the individual cases of the disease being studied were exposed to the source of infection and the period during which illness occurred. Person refers to the characteristics of the individuals who were exposed and who contracted the infection or disease in question. Place refers to the features, factors, or conditions which existed in or described the environment in which the disease occurred. It is from an analysis of the risks associated with these specific epidemiologic variables that hypotheses concerning the agent, source, and mode of transmission, can be formed and tested.

While a particular characteristic of a person or his environment may place that person at an elevated risk of acquiring a particular infection or disease, several characteristics of person, place, or time usually must act in concert to produce an infection or disease in a person.

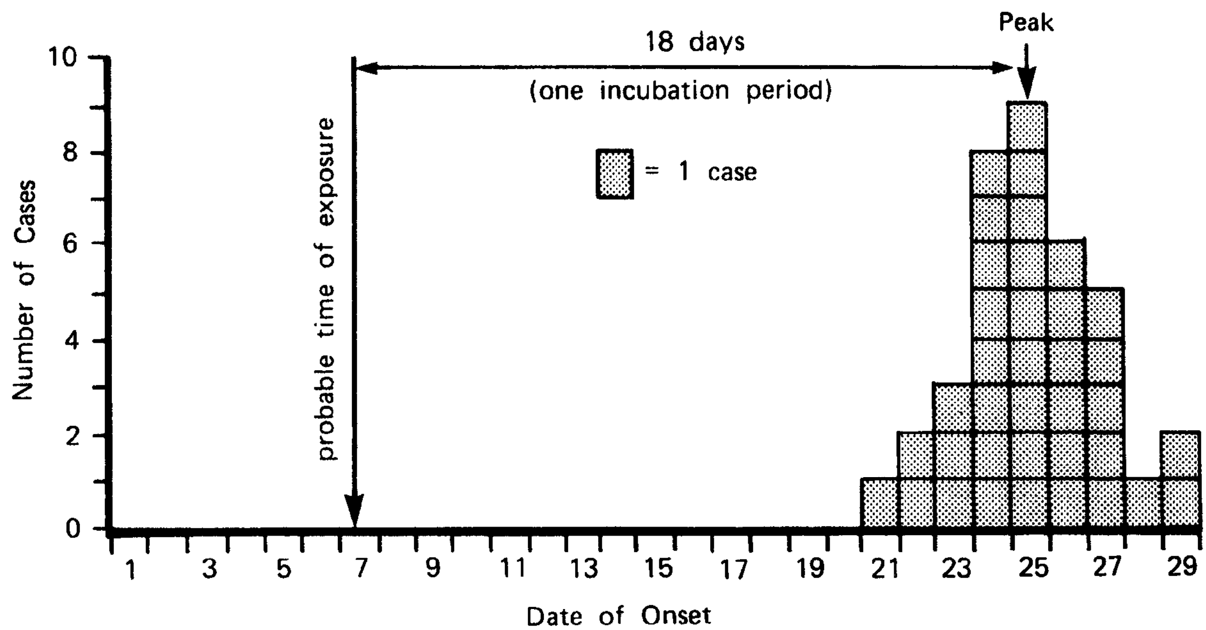
TIME

The common practice in epidemiology is to record the temporal occurrence of disease according to the date, and when appropriate, the hour (generally when the disease suspected has an incubation period of less than 3 days) of onset of symptoms. Subsequently, data from all similar cases may be grouped or examined for various spans of time: an epidemic period, a year, or a number of consecutive years. This kind of analysis of cases by time enables the formulation of hypotheses concerning the time and source of infection, mode of transmission, and causative agent.

Epidemic period: A period during which the reported number of cases of a disease exceeds the expected, or usual, number for that period. Epidemic curves will be discussed in detail in the lesson "Investigation of Disease Outbreaks." Briefly, however, epidemic curves are used to help describe the nature and possibly the period of exposure to the source of infection. In the following example (figure 2) of a common-source outbreak of rubella, count back one incubation period from the peak of the outbreak. The source case (or place of exposure if appropriate) can be identified by answering the question, "where was each of the cases, and who did they contact, on or about the suspected date?"

Figure 2

Date of Onset of Thirty-Seven Cases of Rubella, Sun City, June 1–29

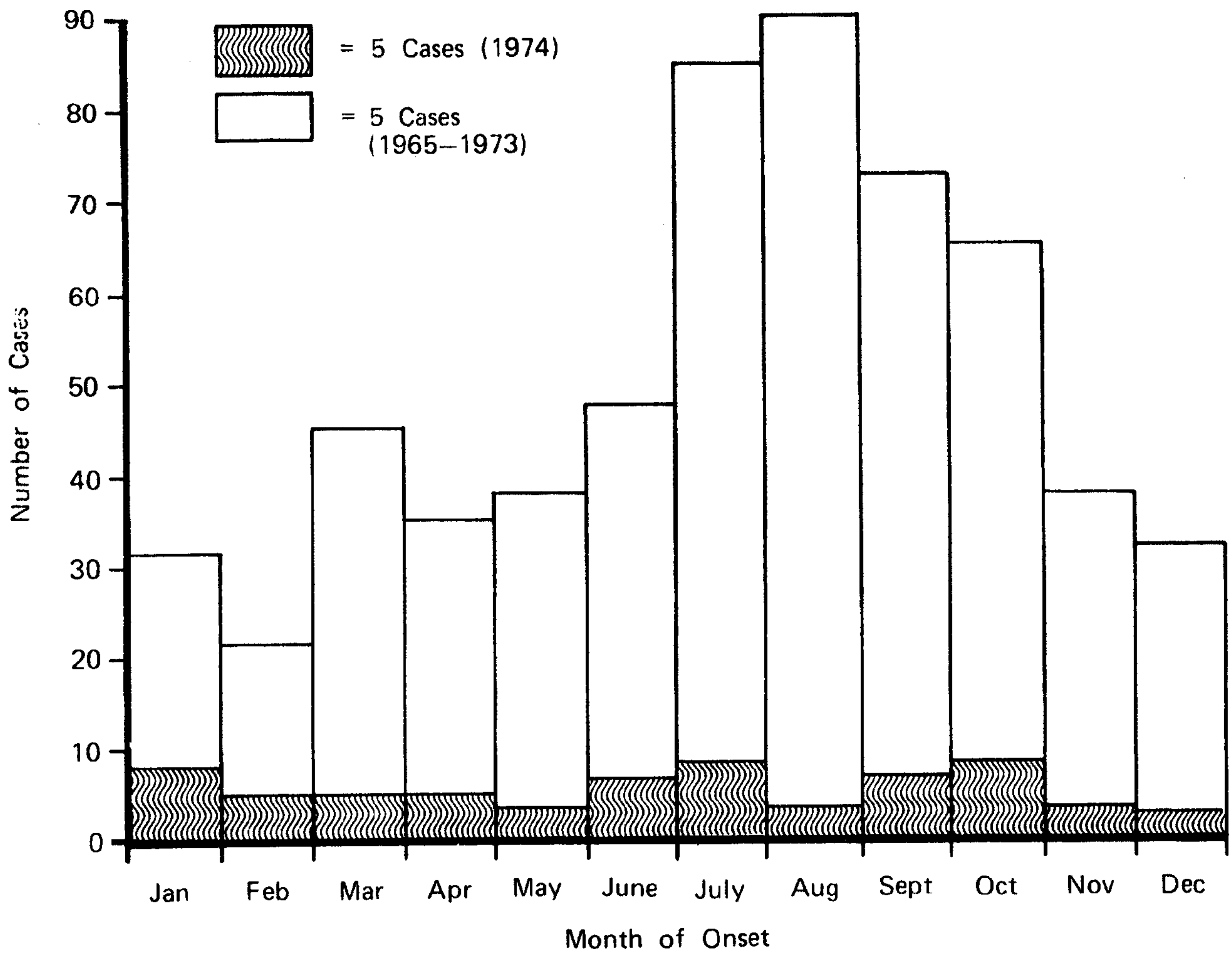


Year: For many diseases the incidence (frequency of occurrence) is not uniform during each of 12 consecutive months. Instead, the frequency is greater in one season than in any of the others. This seasonal variation is associated with variations in the risk of exposure of susceptibles to a source of infection. The risk of exposure, in turn, depends on the mode of transmission of the particular disease, the prevalence of the etiologic agent within the reservoir, and variations in levels of exposure of susceptibles.

For example, in leptospirosis, the principal modes of transmission are contact with infected animals and contact with contaminated water. As can be seen in the graph (figure 3), the greatest incidence of cases occurs during the summer and usually results from contact with infected animals.

Figure 3

Human Leptospirosis, By Month of Onset, United States, 1965–1974

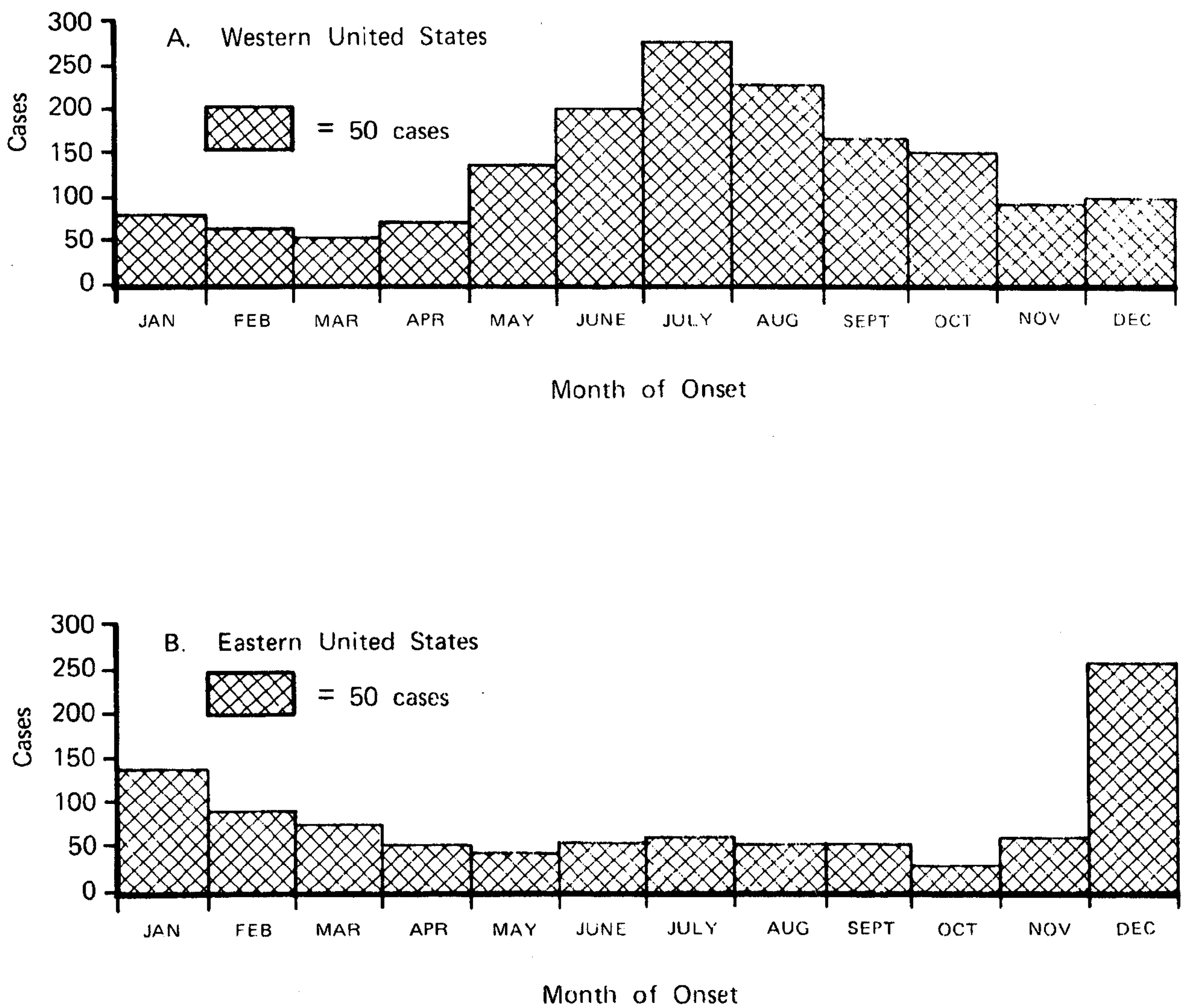


Source: Center for Disease Control, Leptospirosis Surveillance, Annual Summary, 1974, Issued September, 1975.

The incidence of tularemia also demonstrates seasonal variation (figure 4). In the western United States the greatest incidence is in midsummer; in the eastern United States the greatest incidence is in midwinter. The reason is that different modes of transmission are involved: in the West the cases usually result from the bite of an infected tick, while in the East the cases usually result from contact with infected rabbits or from drinking contaminated water.

Figure 4

Reported Cases of Tularemia by Month and Geographic Area, United States – 1960–1968

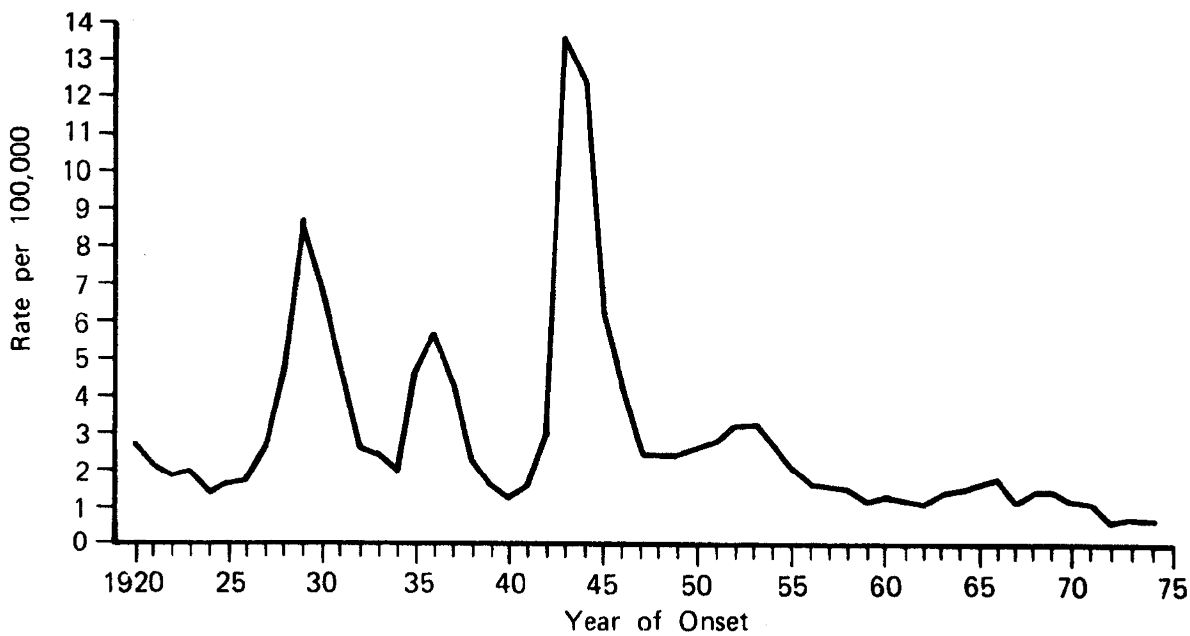


SOURCE: MWMR, March 7, 1970

Periods of consecutive years: Recording the reported cases of a disease over a period of years--by week, month, or year of occurrence--is useful in predicting the probable future incidence of the disease and in planning appropriate prevention and control programs. It also offers clues to the natural history of the disease. For example, the frequency of occurrence of both meningococcal infections and viral hepatitis has been cyclic (figures 6 and 7). The incidence of these diseases increased and subsided at approximately 7-year (sometimes lengthier) intervals. One explanation of this phenomenon is that the population has undergone changes in its susceptibility to these diseases, and the increase in incidence was a consequence of an increase in the number of susceptible individuals in the population. In recent years, however, these cycles have been dampened considerably.

Figure 6

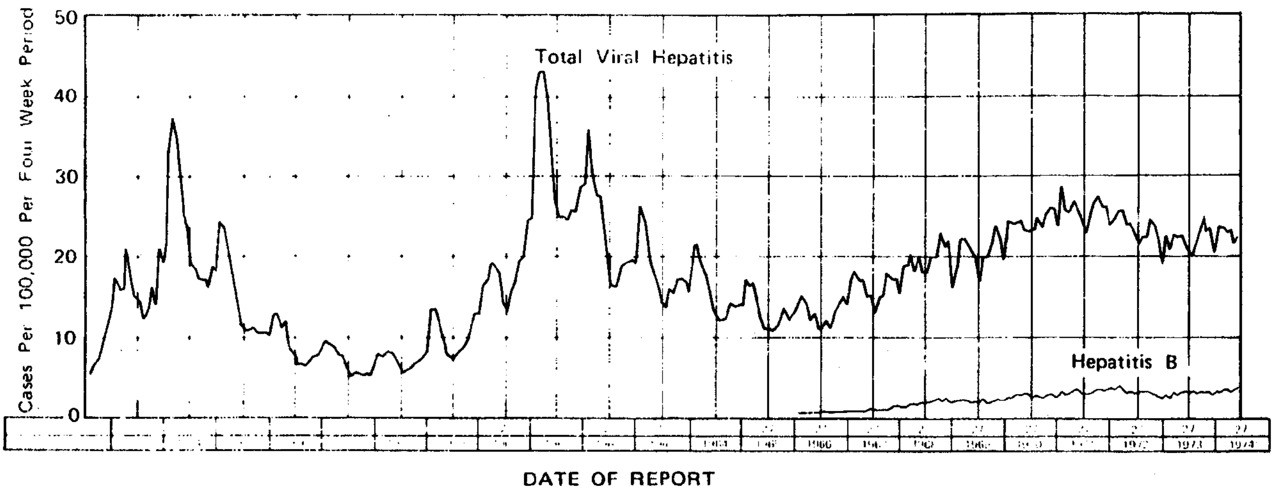
Reported Cases of Meningococcal Infections in the United States, 1920–1974



Source: Annual Summary of MMWR, 1974.

Figure 7

Incidence of Reported Cases of Viral Hepatitis per 100,000 Population in the United States, by Four-week Periods, July 1952—June 1974



Source: Annual Summary of MMWR, 1974

The trend line for tetanus (figure 8) shows a relatively steady decline in incidence over the period shown, from about 0.33 cases per 100,000 population in 1951, and a leveling-off at about 0.05 cases per 100,000 population in 1973, which has lasted to the present time.

Figure 8

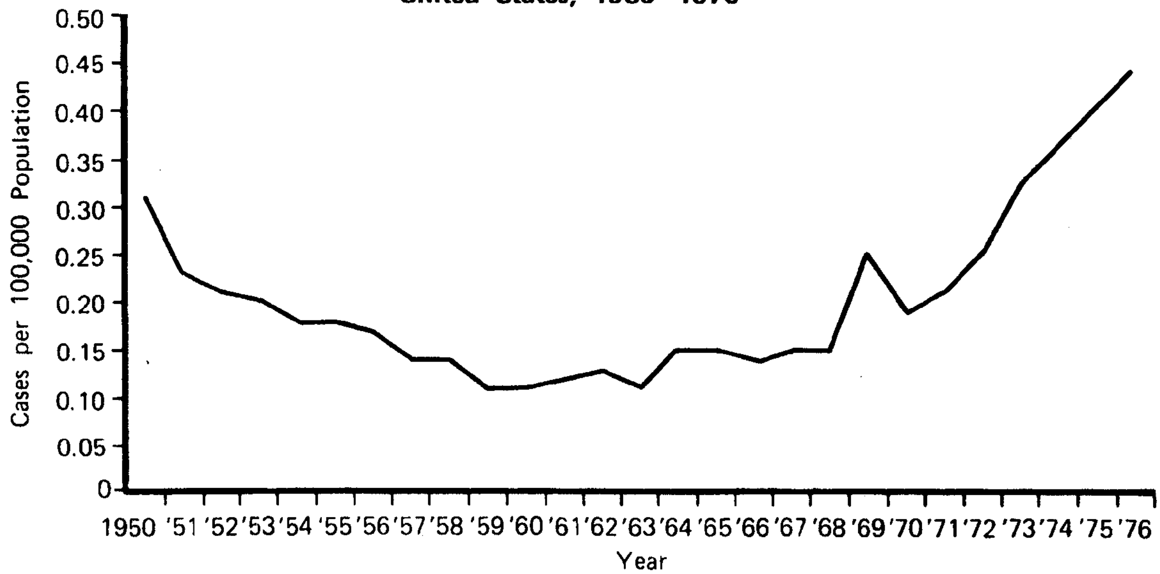
Reported Cases of Tetanus per 100,000 Population by Year, United States, 1950—1976

Source: Annual Summary of MMWR, 1976.

The trend line for Rocky Mountain Spotted Fever (figure 9) reveals, since 1950, a gradual decline in incidence until about 1959 through 1963 (at about 0.11 cases per 100,000 population) and subsequently an increase through the present to its highest point of the period covered, approximately 0.44 cases per 100,000 population). The most likely incidence of each of these diseases in the following year is identified simply by extending the trend line in each of the graphs in accordance with its known pattern.

Figure 9

Reported Cases of Rocky Mountain Spotted Fever per 100,000 Population by Year, United States, 1950–1976



Source: Annual Summary of MMWR, 1976.

PERSON

Persons can be described in terms of either their inherent or their acquired characteristics (such as age, sex, race, immune status, and marital status); their activities (form of work, play, religious practices, customs, etc.); and the circumstances under which they live (social, economic, and environmental conditions). These characteristics, activities, and conditions determine to a large degree which persons are at the greatest risk of acquiring specified infections or of experiencing other undesirable health conditions.

Age: For most diseases, there is more variation in disease frequency by age than by any other variable--and for this reason age is considered the single most useful variable associated with describing the occurrence and distribution of disease. This usefulness is largely a consequence of the association between a person's age and their:

1. potential for exposure to a source of infection
2. level of immunity or resistance, and
3. physiologic activity at the tissue level (which affects, among other things, the manifestation of a disease subsequent to infection).

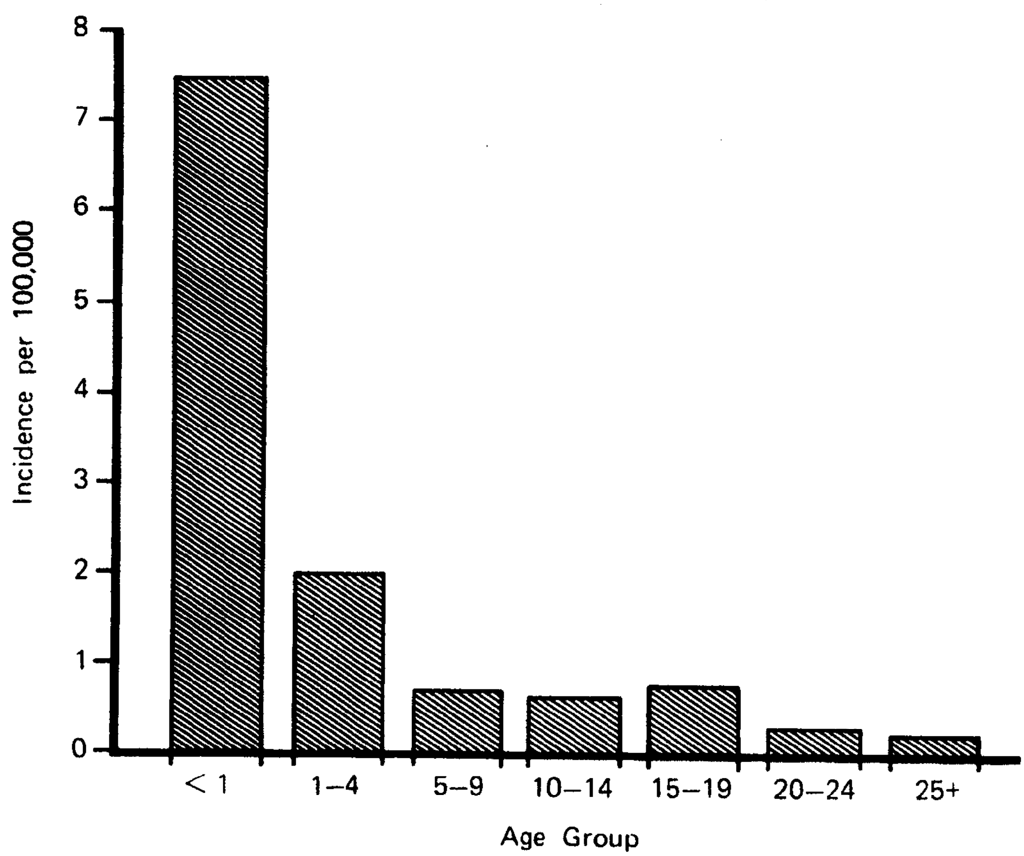
In the analysis of age data, age-groups should be kept relatively small so that differences between groups can be detected. Age data are usually analyzed by 5-year age-groups: 0 to 4, 5 to 9, 10 to 14, and so on. Large groupings such as 0 to 19 years and 20 to 39 years can hide important differences in the distribution of cases. Such differences are useful for the purposes of detecting possible epidemics and establishing hypotheses regarding a source of infection and mode of transmission.

As an example, if a school milk supply were contaminated, and served as a source of infection, the analysis of cases by 5-year age-groups would enable the investigator to identify school-age children as having been exposed, while also revealing that persons in other age-groups were not exposed. If, instead of 5-year age-groups, 10-year age-groups were used, such observations would be difficult, if not impossible, to make.

As an example of this, see figure 10. The peak rate of incidence of meningococcal meningitis occurs in the less-than-one-year age-group. The next highest rate occurs in the one-to-four age-group. Had this information been presented in 10-year age-groups the infants' very high risk could not have been identified.

Figure 10

Incidence of Meningococcal Meningitis per 100,000 Population by Age Group (1,346 cases, 244 of unknown age) in the United States, 1974



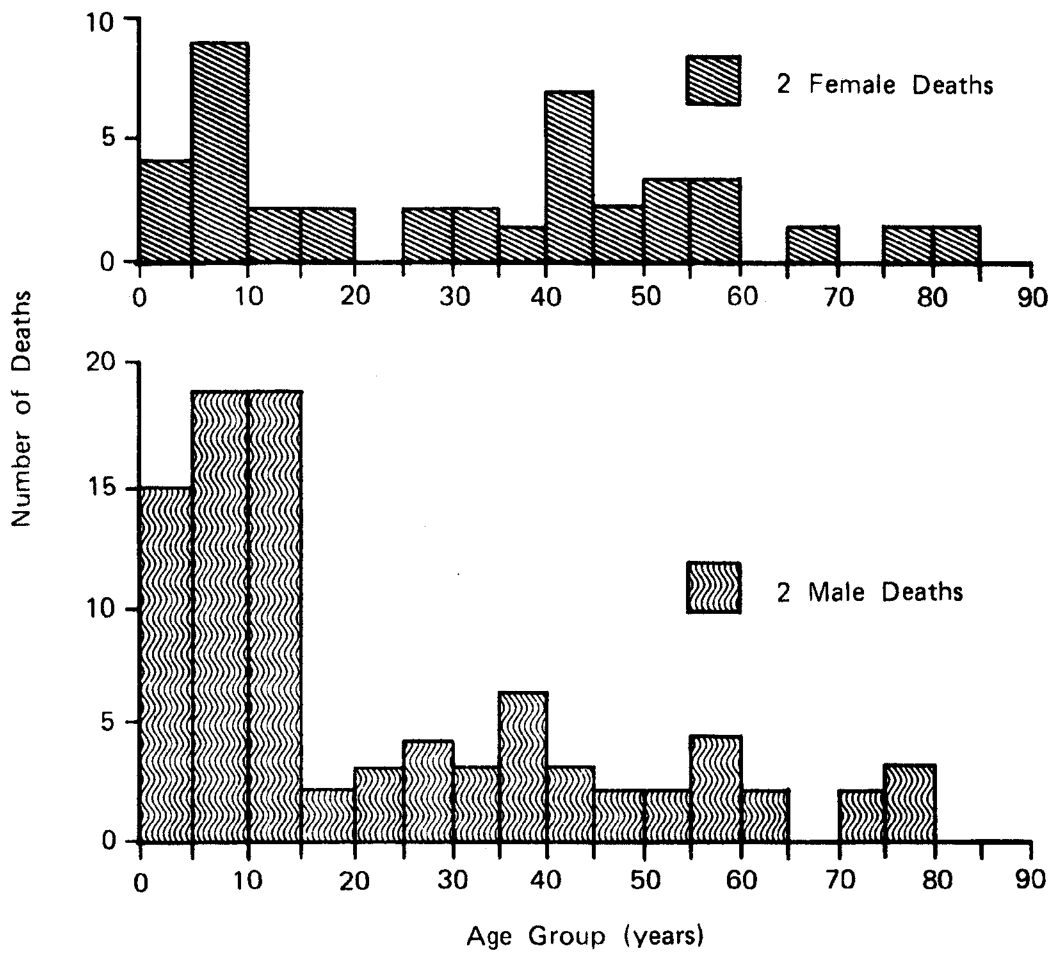
Source: Center for Disease Control MMWR, December 28, 1974.

Sex and Occupation: In general, males experience higher mortality rates than do females for a wide range of diseases. It is the females, however, that, in general, have the higher morbidity rates. In many instances where an infectious disease occurs at a higher rate in members of one sex than it does in the other, the explanation can be found in differing patterns of behavior between the sexes or such activities as recreation, travel, occupation, and so forth, which results in different opportunities for exposure to a source of infection.

Under the age of 15 years there is a large excess of male (compared to female) deaths from rabies (figure 11). This is a result of young boys being at an elevated risk of exposure to an infected animal because of their greater contact with animals in general.

Figure 11

Human Rabies Deaths by Age Group and Sex, United States, 1950–1968



Source: Based on HEW, PHS, CDC, Annual Supplement to the MMWR, 1968.

The number of cases of brucellosis among males far exceeds the number among females, especially between the ages of twenty and fifty years (figure 12). The vast majority of the cases occur among meat-packing plant employees, reflecting this occupation's elevated risk of worker-exposure to the reservoir of the organism.

Figure 12

Human Brucellosis Cases by Age and Sex, United States, 1974*

* 235 reports received with age and sex data of the 246 cases recorded.

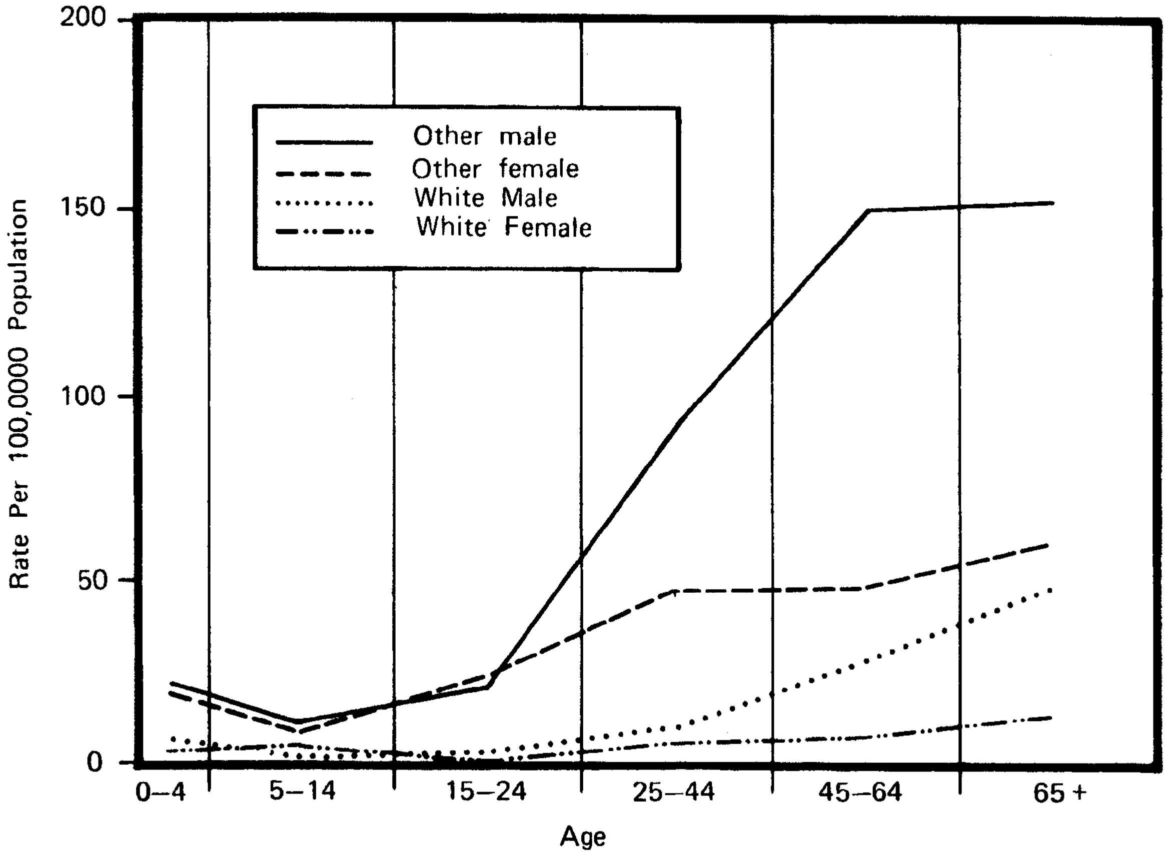
Source: Center for Disease Control: Brucellosis Surveillance, Annual Summary 1974, Issued November, 1975

Ethnic and Racial Groups: It is not unusual for the incidence of a disease to be higher in one ethnic or racial group than in another. Differences in exposure and immunity or resistance to the agent responsible usually account for this disparity.

White persons of all ages, for example, have lower rates of tuberculosis than the members of all other races combined (figure 13). Females 25 or more years of age, regardless of race, usually have a lower attack rate than males of their own race. This is thought to reflect both variations in resistance and in exposure to sources of infection.

Figure 13

Tuberculosis Case Rates by Age, Race, and Sex, in the United States, 1973



Source: HEW, PHS, CDC, Reported Tuberculosis Data, 1973.

PLACE

By definition "place" is a designated geographic area; it can be located by its latitude and longitude. It is often thought of in terms of street address, city, state, region or country, but for the purposes of descriptive epidemiology, place is frequently classified in dichotomous or other mutually exclusive terms: urban or rural; resident or nonresident; domestic or foreign; internal or external; institutional or noninstitutional; and so forth. The association of a disease with a place implies that the factors of greatest etiologic importance are present either in the inhabitants or in the environment or both.

Urban/rural differences: In general, disease spreads more rapidly in urban areas than in rural areas--primarily because the greater population density of the urban area provides more opportunities for susceptible individuals to come into contact with a source of infection. This is illustrated by measles (table 3), which occurs at an earlier age in urban children than in rural children.

Table 3

Recent Outbreaks of Measles in the U.S., by Age Group of the Cases, and Place of Residence (Urban or Rural), 1969–1971

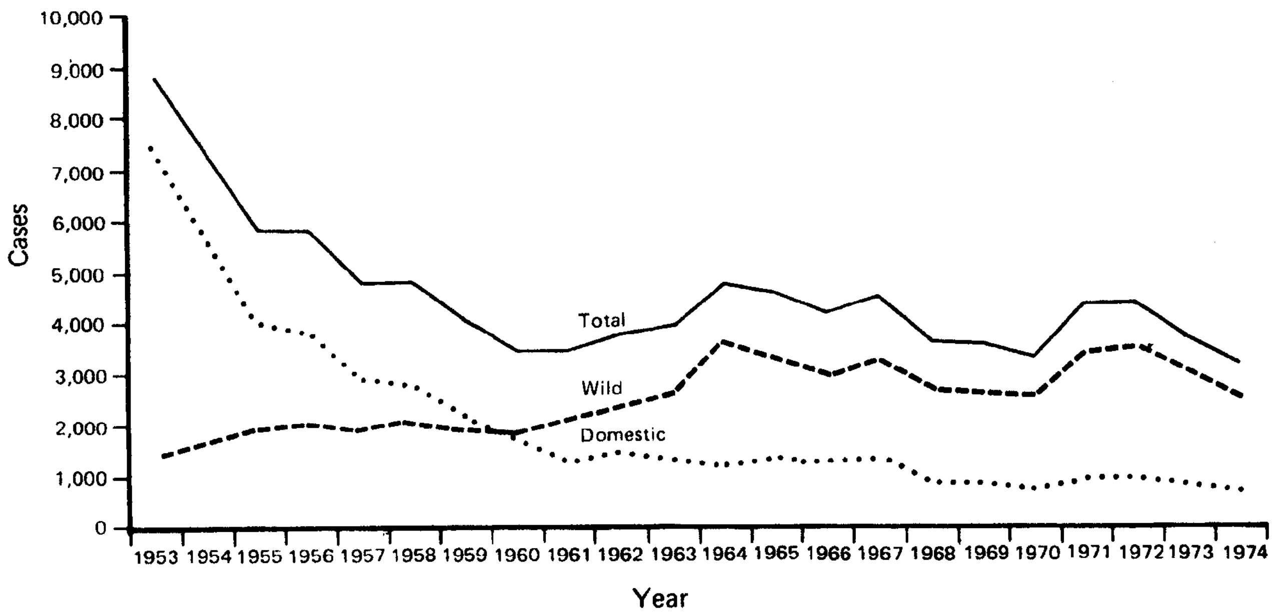
Age Groups	Cases			
	Number		Percent	
	Urban	Rural	Urban	Rural
< 1	1038	109	13.7	6.8
1 – 4	4023	280	53.1	17.6
5 – 9	1843	970	24.4	61.1
10 – 14	507	211	6.7	13.3
15+	162	19	2.1	1.2
TOTAL	7573	1589	100.0	100.0

Source: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control. December 1971. Measles Surveillance Report No. 8, page 4.

However, those diseases which are transmitted from animal to man, including vectorborne diseases, often have a greater incidence in the rural and suburban areas. This is due to the greater opportunity for contact with an infected animal or vector (figure 14).

Figure 14

Cases of Rabies in Wild and Domestic Animals by Year, United States, 1953–1974



Source: HEW, PHS, CDC, Zoonosis Surveillance: Rabies, 1974 Annual Summary, Issued March, 1976

Changes in the areas of greatest risk of disease transmission may also occur as a result of the successful implementation of vector control measures as shown in figures 15A and 15B. Here, the populations at the greatest risk of exposure to a source of infection (for typhus) changed from the urban to the suburban area as the former implemented effective vector control measures and the latter increased in population.

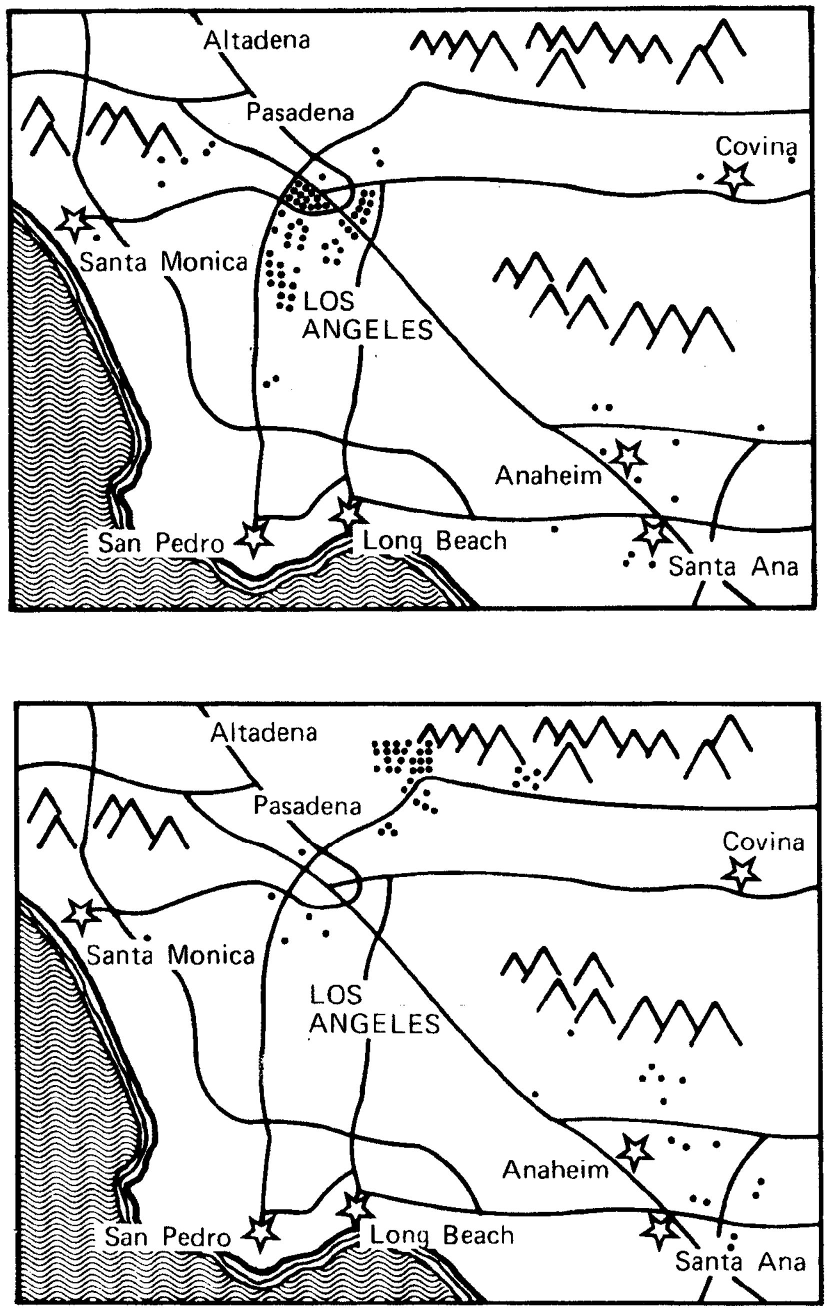
Figures 15 A and 15 B

Probable Places of Exposure of Cases of Typhus Fever in Los Angeles, California for Two Periods, 1946–1948 and 1951–1967

A. 1946–1948

• 1 Case

B. 1951–1967



Source: Adams, et.al. "The Changing Ecology of Murine (Endemic) Typhus in Southern California, "American Journal of Tropical Medicine and Hygiene, 19:2 ;1970

Socioeconomic-area differences: Communities can usually be divided into geographic areas which are relatively homogenous with respect to the socioeconomic circumstances of the residents. This division is possible, at least in this country, because persons of similar socioeconomic conditions tend to live near each other. It commonly has been observed that the incidence rate of many diseases, both communicable and chronic, varies inversely with socioeconomic status: as socioeconomic status increases, so generally does individual immunity and resistance and the quality of the immediate environment (tables 4 and 5).

Table 4

Average Annual Number of Infant Deaths and Infant Deaths per 1,000 Live Births, by Socioeconomic Strata, City "X", 1961–1965

Socioeconomic Stratum	Average Annual Number of Deaths	Average Annual Rate/1000 live births
Upper	1.8	14.1
Middle	16.2	35.7
Lower	182.4	63.3
TOTAL	200.4	58.0

Table 5

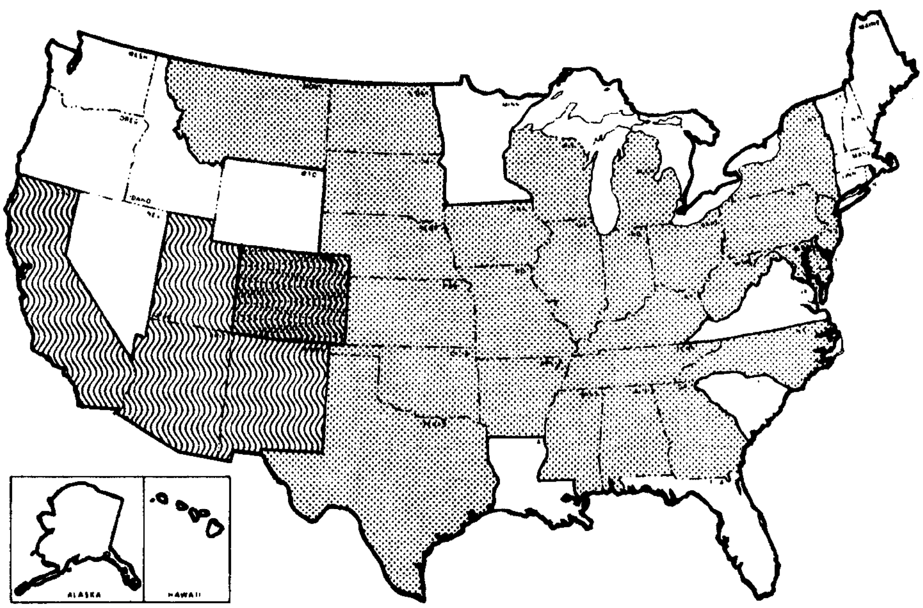
Average Annual Number of Newly Diagnosed Cases of Tuberculosis and Rate per 100,000 Population, by Socioeconomic Strata, City "X", 1961–1965

Socioeconomic Stratum	Average Number cases/year	Rate/100,000
Upper	1.5	21.1
Middle	5.0	20.4
Lower	73.3	85.4
TOTAL	79.8	67.9

<u>Differences in large geographic areas within a country</u>: Geographic variations in the incidence of infectious diseases commonly result from variations in the geographic distribution of the reservoirs or vectors of the disease or in the ecological requirements of the disease agent. Figure 16 illustrates this.

Figure 16

Geographic Distribution of Human Cases of Two Vectorborne Diseases (St. Louis Encephalitis and Plague), United States, 1975



States Reporting St. Louis Encephalitis (1,995 cases)

States Reporting Plague (20 cases)

Source: Based on data in Morbidity and Mortality Weekly Report, Annual Supplement (1975 Summary), CDC.

Countries: There are many infectious diseases that are found only infrequently in the United States--usually because the reservoir and/or the vector of the infectious agent cannot, or does not, exist in this country. When cases of these diseases are found in the United States, they are usually persons who reside in, or have travelled to, areas where the disease is endemic. Table 6, for example, shows that most of the cases of malaria found in the United States during 1969 were among persons who had been in Vietnam.

Table 6

Cases of Malaria by Area of Acquisition and Plasmodium Species Responsible, United States, 1969

Area of Acquisition	Species			
	Vivax	Falciparum	Other	Total
Africa	15	28	15	58
Asia	2957	503	213	3673
Vietnam	2921	496	212	3629
All Other	36	7	1	44
Central America and Caribbean	9	4	2	15
Europe	0	0	1	1
North America	10	3	4	17
South America	1	1	0	2
Unknown	22	9	9	40
TOTAL	3014	548	244	3806

Source: HEW, PHS, CDC, Malaria Surveillance, 1969 Annual Report.

CURRENT EPIDEMIOLOGIC PRACTICE

As can be seen from the previous examples, knowledge of the patterns of occurrence of diseases is useful and important. This knowledge is usually obtained through the surveillance and investigation of the disease.

Disease Surveillance

Disease surveillance is the continued and close observation of the distribution and trends of disease incidence. This is accomplished through the systematic collection, consolidation, and evaluation of morbidity and mortality reports and other relevant data, and dissemination of the resultant data and interpretations to those involved in disease control.

The other relevant data referred to includes population immunization levels, information from individual case investigations, epidemic reports, laboratory isolations, and information available from disease registers and screening surveys.

Disease surveillance enables epidemiologists to study the incidence and distribution of disease in order to identify associated causal factors relating to the agent, host, and environment. Without such information, practical and efficient preventive programs cannot be developed.

A distinction is made between disease surveillance and personal surveillance. Personal surveillance is defined as the practice of close medical or other vigil over contacts, but without restricting their movements, in order to enable prompt recognition of infection or illness.

Disease Investigation

Morbidity reports are the largest single source of surveillance data. The importance of morbidity case reports is reflected by the numerous ways in which they are used by epidemiologists. By investigating reported cases, additional unreported and/or unrecognized cases may be discovered. Identification of such individuals is important in preventing further spread of disease.

Analyses of the known cases during a specified period can be used to identify endemic levels, detect epidemics, characterize disease behavior, set priorities in public health programs, and evaluate progress in disease control.

Case reports are used routinely to find the source of infection in order to eliminate it or prevent further transmission to susceptibles.

From what has already been discussed, it should be apparent that the epidemiologist is dependent upon a number of other disciplines. Clinicians are the foundation of the morbidity and mortality reporting systems. They are assisted by biochemists, pathologists, and others in their diagnostic work. Biostatisticians help in the organization and interpretation of epidemiologic data.

Epidemiologic Studies

The practice of epidemiology consists of descriptive, analytic, and experimental disease studies to identify causal factors.

The descriptive approach involves the study of disease incidence and distributions by such variables as time, person, and place. On the basis of such studies, factors may be identified which appear to be causally related to disease incidence.

Analytic disease studies, retrospective or prospective, may then be conducted to further identify the causal relationships of factors identified in descriptive studies.

Experimental studies provide a basis for proving a causal relationship. Such studies have been conducted largely with laboratory animal populations. Experimental studies applied to human populations have been restricted primarily to testing vaccines and other preventive measures.

Glossary

Some of the terms included in this glossary have meanings other than those shown here. However, these definitions are the meanings usually used in the context of disease surveillance, investigation, and control.

GLOSSARY

Agent	A biological, physical, or chemical entity capable of causing disease.
Anamnestic response	The accelerated rise in antibody titer in a person who had previously developed a primary immune response to the particular antigen.
Antibiogram	A list of those antibiotics to which a particular microorganism is sensitive or resistant.
Antibiotic sensitivity testing	The identification of the concentration of various antibiotics to which a particular microorganism is sensitive.
Antibody	A globulin, found in tissue fluids and blood serum, produced in response to the stimulus of a specific antigen, and capable of combining with that antigen to neutralize or destroy it. Globulins are often referred to as "immune substances."
Antigen	That portion or product of a biologic agent capable of stimulating the formation of specific antibodies.
Antigenic Character	The chemical arrangement of the antigenic components of an agent, which arrangement and components are unique to each species or strain of agents, and which are responsible for the specificity of immunity resulting from infection with that agent.
Antigenicity	Ability of an agent or its products to stimulate the formation of antibodies.
Antisepsis	The prevention of sepsis by inhibition or destruction of the causative organism.
Antitoxin	Antibody to the toxin of a microorganism, usually a bacterial exotoxin. Antitoxin combines with a specific toxin, in vivo and in vitro, with the consequent neutralization of toxicity.
Arboviruses	Viruses that are transmitted from one host to another by one or more kinds of arthropods.
Asepsis	The absence of infectious microorganisms.

Aseptic technique	Precedures designed to exclude infectious agents.
Attack Rate	See Rate
Bacteriophage	A virus that lyses bacteria.
Carrier	A person or animal that harbors a specific infectious agent (but manifests no discernible clinical disease) and is a potential source of infection for man or animals. The carrier state can occur in an individual with an infection inapparent throughout its course or, if the infection leads to disease, the carrier state may occur during the incubation, convalescent, and post-convalescent periods. While in these states, a person or animal is commonly referred to as incubatory carrier or convalescent carrier. The carrier state can be of short or long duration (temporary carrier or chronic carrier).
Case	An infected or diseased person or animal having specific clinical, laboratory and epidemiologic characteristics. <u>Confirmed case</u> A person from whom a disease-producing agent has been isolated and identified or from whom has been obtained other laboratory evidence of the presence of an etiologic agent, i.e., a four-fold or greater rise in antibody titers between acute and convalescent serum specimens, whether or not that person has a clinical syndrom indicative of the disease caused by the agent. <u>Presumptive case</u> A person with a clinical syndrome compatible with a disease but without laboratory confirmation of the etiologic agent.
Case Fatality Rate	See Rate
Cause-Specific Death Rate	See Rate
Chemoprophylaxis	The administration of a chemical, including antibiotics, to prevent the development of an infection or the progression of an infection to clinical disease.
Cohort	Any defined group of persons selected for a special purpose or study.

Cohort Study	See Prospective Study"
Colonization	Propagation of a microorganism on or within a host without causing cellular injury. A colonized host can serve as a source of infection.
Communicability (Period of)	The interval during which a person or animal that has an infectious disease is a potential source of infection.
Communicable Disease	An illness which is caused by a specific infectious agent or its toxic products, and which arises through transmission of that agent or its products from a reservoir to a susceptible host. Such transmission can be either direct, as from an infected person or animal, or indirect, through the agency of an intermediate plant or animal host, vector, or the inanimate environment.
Contact	A person or animal that has been in such association with an infected person or animal, or a contaminated environment, as to have had an opportunity to acquire the etiologic agent.
Contamination	The presence of an etiologic agent on a body surface; also on or in clothing, bedding, toys, surgical instruments or dressings, or other inanimate articles or substances, including water, milk and food.
Crude Death Rate	See Rate
Culture	The deliberate propagation of microorganisms on or in substances (media) especially prepared for this purpose.
Decontamination	The removal of an etiologic agent (a contaminant) from an animate or an inanimate surface.
Disease	A deviation from normal health status associated with a characteristic sequence of signs and symptoms and caused by a specific etiologic agent.
Disinfection	The destruction of infectious microorganisms on the surface of an object, usually by chemical means.

Droplets	Liquid particles expelled into the air during the act of talking, spitting, singing, coughing, or sneezing. Droplets are formed through aerosolization of secretions present in the mouth, nasopharynx and bronchi. They can contain infectious microorganisms.
Droplet Nuclei	The dried residues of droplets which may contain one or more infectious microorganisms. In contrast to droplets, droplet nuclei can remain suspended in the air for long periods.
Endemic	The constant presence, or the usual prevalence, of a disease or infectious agent in human populations within a given geographic area.
Enzootic	The constant presence or usual prevalence of a disease or infectious agent in animal populations of a given geographic area.
Epidemic	The occurrence of cases of similar nature in human populations in a particular geographic area clearly in excess of the usual incidence. <u>Common-source epidemic</u> An epidemic in which one human or one animal or specific vehicle has been the main means of transmitting the agent to the cases identified. <u>Propagated-source epidemic</u> An epidemic in which infections are transmitted from person to person or animal to animal in such a fashion that cases identified cannot be attributed to agents transmitted from a single source.
Epidemiologist	A person who applies epidemiologic principles and methods to the prevention and control of disease.
Epidemiology	The study of the distribution and determinants of disease in human populations.
Epizootic	The occurrence of cases of similar nature in animal populations in a particular geographic area clearly in excess of normal incidence. Epizootics may result from common or propagated sources of infection.

Etiology	The study or theory of the causation of disease; the sum of knowledge regarding causes.
Exposure	The opportunity of a susceptible host to acquire an infection by either a direct or indirect mode of transmission. An effective exposure is one in which the exposure actually results in infection.
Fomites	A subclass of vehicles, including inanimate objects such as articles of clothing, which can become contaminated and transmit agents.
Herd Immunity	Resistance of a group to the introduction and spread of an infectious agent. Such resistance is based on the immunity of a high proportion of individual members of the group and one the uniform distribution of the immunes within the group.
Host	Organisms, simple or complex, including man, that are capable of being infected by a specific agent. <u>Primary (definitive) hosts</u> Hosts in which the parasite attains maturity or passes through its sexual stage <u>Secondary (intermediate) hosts</u> Hosts in which the parasite exists in the larval stage or other asexual stage. <u>Accidental (dead-end) host</u> A host that has no role in the propagation or transmission of a particular infectious agent.
Host Range	The extent of the variety of species susceptible to infection by a specific kind of agent.
Hypothesis	An unproven assertion or statement, based on available information, which commonly deals with the identity of an etiologic agent, the source of infection and the mode of transmission. Its role is to provide a rational basis for further investigation.
Illness	A condition of pronounced deviation from the normal healthy state; sickness. Illness can be the result of disease or injury.

Immune Serum Globulin	A sterile solution of globulins which contain those antibodies normally present in adult human blood.
Immunity	See Resistance
Immunodeficient	Lacking in the ability to produce antibodies in response to an antigen.
Incidence	Number of new cases of a disease occurring within a particular population during a specified period of time.
Incidence Rate	See Rate
Incubation Period	The interval between effective exposure of a susceptible host to an agent (infection) and onset of clinical signs and symptoms of disease in that host.
Index Case	The first case among a number of similar cases which are epidemiologically related. Index cases are often identified as a source of contamination or infection
Infected Person	A person who harbors an infectious agent, whether or not the infection is accompanied by disease. An infectious person is one from whom the infectious agent can be naturally acquired by exposed susceptibles.
Infection	The entry and multiplication of an infectious agent in body tissues of man or animal resulting in cellular injury. <u>Inapparent infection</u> An infection resulting in no perceptible clinical signs and symptoms. <u>Apparent infection</u> An infection resulting in clinical signs and symptoms (disease).
Infectious Agent	An organism, usually a microorganism, but including helminths, that is capable of producing infection or infectious disease.
Infectious Disease	A disease of man or animal resulting from an invasion of the body by pathogenic agents and the reaction of the tissues to these agents and/or the toxins they produce.
Infectivity	The ability of an agent to infect a host.

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Infectious Disease	A disease of man or animal resulting from an invasion of the body by pathogenic agents and the reaction of the tissues to these agents and/or the toxins they produce.
Infectivity	The ability of an agent to infect a host.

Infestation	The lodgment, development, and reproduction of arthropods on the body or in the clothing. Infested articles or premises are those which harbor animals, especially arthropods and rodents.
Inflammation	Normal tissue response to cellular injury or foreign material, characterized by dilation of small blood vessels (capillaries) and mobilization of defense cells (blood and tissue leucocytes and phagocytes).
Isolation	The separation, for the period of communicability, of infected persons or animals from those that are not infected, in such places and under such conditions as will prevent the direct or indirect transmission of the infectious agent from those infected to those who may be susceptible or who may spread the agent to others.
Interference Phenomenon	State of temporary resistance to infections by viruses. Such resistance is induced by an existing virus infection and is attributed in part to the protein, interferon.
Interferon	Low molecular-weight protein produced by cells infected with viruses. Interferon has the property of blocking viral infection of healthy cells and suppressing viral multiplication in cells already infected; interferon is active against a wide range of viruses.
Invasiveness	The ability of a microorganism to enter the body and to spread throughout the tissues. Such dissemination of microorganisms may or may not result in infection or disease.
Investigations	Studies conducted to identify the source of individual cases and the mode of the agent's transmission.
Latent Period	The time interval between exposure to toxic chemical agents and the onset of signs and symptoms of illness.
Morbidity Rate	See Rate
Morbidity Report	An official report by a diagnostician or other responsible person notifying an appropriate authority of the occurrence of a reportable disease in man or in animals.

Mortality Rate .... See Rate

Natality Rate .... See Rate

Natural History of a Disease ...... The comprehensive description of the characteristics, sources, and distribution of a disease agent; the characteristics and ecology of the agent's reservoir; mechanisms of transmission; and its effect on man.

Nosocomial Infection .... An infection resulting from exposure to a source within a health-care facility. The term is applied to such infections occurring among inpatients, visitors, and hospital personnel.

Outbreak .... The occurrence of two or more cases which are epidemiologically related.

Pandemic .... An epidemic disease affecting people in several countries or continents.

Parasite .... An organism (often microbial) which lives at the expense of the host in or on which the organism resides. Parasites are not necessarily harmful to their host.

Pathogen .... An agent capable of causing disease.

Pathogenicity .... The capacity of an agent to cause disease in a susceptible host. See also virulence.

Phage Typing .... The characterization of a bacterium by the identification of those bacteriophages to which the bacterium is susceptible. A means of strain differentiation.

Phagocyte .... A cell which engulfs and destroys foreign particles or microorganisms by digestion.

Prevalence Rate .... See Rate

Preventive Medicine .... A branch of medicine which has as its primary purpose the prevention of physical, mental, and emotional disease and injury; secondarily, it is concerned with the slowing of the progress of disease and the conserving of maximal function.

Prodromal Period .... The prodromal period is that lapse of time between the first symptom of disease and the first sign or symptom upon which a diagnosis can be based.

Prodrome .... A symptom indicating the onset of disease.

Prospective Study "Cohort Study" .... A method of identifying causal associations between host or environmental characteristics and disease occurrence. Such associations are identified by comparing the future disease experience of two defined population groups, only one of which has the characteristics under study.

Quarantine .... The application of measures to prevent contact between uninfected persons and persons suspected of being infected.

Rate .... A measure of the frequency with which a specified event occurs in a particular population either at a certain instant or during a particular period. The three major types of rates used in public health practice are the morbidity rate, the mortality rate, and natality rate.

Morbidity rate A measure of the frequency of illness or disease in a population. There are two major groups of morbidity rates: incidence and prevalence rates.

An incidence rate is a measure of the frequency of cases of disease in a particular population, the times of onset of which occurred during a specified period of time. Incidence rates which are calculated for narrowly defined populations (in terms of age, sex, etc.) during intervals of time, as in epidemics, are often called attack rates. Attack rates are usually expressed as a percent. A secondary attack rate is a measure of the frequency of new cases of a disease among close contacts of known cases. Secondary attack rates are usually calculated for household contacts.

A prevalence rate is a measure of the frequency of all current cases of a disease (regardless of the time of onset) within a particular population, either at a specified instant (a point-prevalence rate) or during a specified period (a period-prevalence rate).

Mortality rate A measure of the frequency of deaths within a particular population during a specified interval of time. If deaths from all causes are included, the rate is called a crude death rate; if only deaths from a specified cause are included, the rate is called a cause-specific death rate. A case fatality rate is a measure of the frequency of deaths due to a particular disease among members of a population who have the disease.

Natality rate A measure of the frequency of births in a particular population during a specified period of time.

Ratio .... A measure of the frequency of one group of events (e.g., the number of males having a specified disease) relative to the frequency of a different group of events (e.g., the number of females having the specified disease).

Reservoir of Infectious Agents .... Any human being, animal, arthropod, plant, soil, or inanimate matter in which an infectious agent normally lives and multiplies and upon which it depends primarily for survival, and from which the agent can be transmitted to a new host.

Resistance .... The sum total of host mechanisms which interpose barriers to invasion or multiplication of infectious agents, or that prevent damage by the agent's toxic products.

Immunity That resistance usually associated with possession of antibodies that have an inhibitory effect on a specific microorganism, or its toxin, that causes a particular infectious disease.

Passive immunity is acquired either naturally (by maternal transfer) or artificially (by inoculation of specific protective antibodies--convalescent or immune serum, or immune serum globulin). Passive immunity is of brief duration, days or months.

Active immunity that lasts months to years is acquired either naturally (by infection, with or without clinical manifestations), or artificially (by inoculation of fractions or products of the infectious agent or of the agent itself, in killed, modified or variant form.

Inherent resistance An ability to resist disease without action of antibodies or of specifically developed tissue response. Inherent resistance commonly rests in anatomic or physiologic characteristics of the host, and can be either genetic or acquired, permanent or temporary.

Retrospective Study "Case-Control," "Case History" .... A method of identifying causal associations between disease occurrence and either host or environmental characteristics. These causal associations are identified by comparing the exposure histories of two defined population groups--one whose members have the disease and one whose members do not.

Rickettsia .... A class of microbial agents resembling small bacteria and multiplying by simple fission, but only within a living cell.

Risk .... The likelihood that a person having specified characteristics (e.g., age, sex, immune status) will acquire a specified disease.

Secondary Attack Rate .... See Rate

Sepsis .... The presence of pathogenic microorganisms or their toxins in the blood or other tissue.

Serotyping .... The characterization of a microorganism by the identification of the antigens possessed by that organism. A means of strain-differentiation.

Sign .... Objective evidence of a disease.

Source of Contamination .... The person, animal, or inanimate substance responsible for the presence of an agent in or upon a vehicle.

Source of Infection .... The person, animal, object, or substance from which an infectious agent is transmitted to a host.

Sporadic Case	A case that has, as far as is known, no epidemiologic relationship to any other cases.
Sterilization	The complete destruction of microorganisms on or in an object, usually by means of heat or chemicals.
Subclinical Case	See Infection, Inapparent
Surveillance of Disease	The continuing scrutiny of all those aspects of the occurrence and spread of a disease that are pertinent to effective control.
Surveillance of Persons	The practice of close medical or other observation of the health of contacts (without restricting their movements) to promote prompt recognition of infection or illness in these contacts if it occurs.
Susceptible	A person or animal lacking sufficient resistance to a particular pathogenic agent to prevent disease if or when exposed.
Suspect	A person whose medical history, symptoms, and possible exposure to a source of infection suggest that he may have, or be developing, some infectious disease.
Symptom	Subjective evidence of a disease.
Syndrome	The set of signs and symptoms which typify a particular disease.
Toxin	Proteins or conjugated protein substances which are lethal to other organisms. They are produced by some higher plants, certain animals, and pathogenic bacteria. The high molecular weight and antigenicity of toxins differentiates them from simple chemical poisons and vegetable alkaloids. <u>Endotoxin</u> A toxin found within bacterial cells but not found in cell-free filtrates of intact bacteria. Endotoxins are released from a bacterium when its cell wall is ruptured. <u>Exotoxin</u> A toxin produced by a bacteria that is released by the bacterial cell into the culture medium (or host) and hence found in cell-free filtrates and cultures of intact bacteria.

Toxoid	A preparation containing detoxified toxin. Toxoids are used to induce specific active immunity to disease.
Transmission	The direct (contact or droplet spread) or indirect (vectorborne, vehicle-borne, airborne) transfer of an infectious agent from a reservoir to a susceptible host.
Vaccine	A preparation containing killed or living whole microorganisms or a fraction of the organisms having antigenic properties. Vaccine is employed to induce in the recipient a specific active immunity to an infectious agent.
Vector	An arthropod which transfers an infectious agent from a source of infection to a susceptible host.
Vehicle	An object or substance that is a source of infection or intoxication.
Virulence	The degree of pathogenicity of an infectious agent.
Vital Statistics	Data relating to birth, death, marriage, divorce, and illness (morbidity).
Zoonosis	An infection or an infectious disease transmissible under natural conditions between animals and man.

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